**Relationships Between Species**

Within ecosystems, different species interact in different ways. These interactions can have positive, negative, or neutral impacts on the species involved (Table 4).

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| **Table 4.** Relationships between individuals of different species. | | |
| **Type of interaction** | **Effect of interaction** | **Examples** |
| Competition | Both species are harmed (population growth rates are reduced). | Oak trees and maple trees competing for light in a forest, wading birds foraging for food in a marsh |
| Predation  Parasitism | One species benefits, one is harmed. | Predation: wolf and rabbit Parasitism: flea and wolf |
| Mutualism | Both species benefit. Relationship may not be essential for either. | Humans and house pets, insect pollination of flowers |
| Commensalism | One species benefits, one is not affected. | Maggots decomposing a rotting carcass |
| Amensalism | One species harms another (typically by releasing a toxic substance), but is not affected itself. | Allelopathy (plants that produce substances harmful to other plants): rye and wheat suppress weeds when used as cover crops, broccoli residue suppresses growth of other vegetables in the same plant family |

Each species in an ecosystem occupies a niche, which comprises the sum total of its relationships with the biotic and abiotic elements of its environment—more simply, what it needs to survive. In a 1957 address, zoologist George Evelyn Hutchinson framed the view that most ecologists use today when he defined the niche as the intersection of all of the ranges of tolerance under which an organism can live [(footnote 5)](http://www.learner.org/courses/envsci/footnote/unit4.html). This approach makes ecological niches easier to quantify and analyze because they can be described as specific ranges of variables like temperature, latitude, and altitude. For example, the African Fish Eagle occupies a very similar ecological niche to the American Bald Eagle (Fig. 13). In practice it is hard to measure all of the variables that a species needs to survive, so descriptions of an organism's niche tend to focus on the most important limiting factors.

The full range of habitat types in which a species can exist and reproduce without any competition from other species is called its [fundamental niche](http://www.learner.org/courses/envsci/glossary/definition.php?invariant=fundamental_niche). The presence of other species means that few species live in such conditions. A species' [realized niche](http://www.learner.org/courses/envsci/glossary/definition.php?invariant=realized_niche) can be thought of as its niche in practice—the range of habitat types from which it is not excluded by competing species. Realized niches are usually smaller than fundamental niches, since competitive interactions exclude species from at least some conditions under which they would otherwise grow. Species may occupy different realized niches in various locations if some constraint, such as a certain predator, is present in one area but not in another.

In a classic set of laboratory experiments, Russian biologist G.F. Gause showed the difference between fundamental and realized niches. Gause compared how two strains of *Paramecium*grew when they were cultured separately in the same type of medium to their growth rates when cultured together. When cultured separately both strains reproduced rapidly, which indicated that they were adapted to living and reproducing under the same conditions. But when they were cultured together, one strain out-competed and eventually eliminated the other. From this work Gause developed a fundamental concept in community ecology: the[competitive exclusion principle](http://www.learner.org/courses/envsci/glossary/definition.php?invariant=competitive_exclusion_principle), which states that if two competitors try to occupy the same realized niche, one species will eliminate the other [(footnote 6)](http://www.learner.org/courses/envsci/footnote/unit4.html).

Many key questions about how species function in ecosystems can be answered by looking at their niches. Species with narrow niches tend to be specialists, relying on comparatively few food sources. As a result, they are highly sensitive to changes in key environmental conditions, such as water temperature in aquatic ecosystems. For example, pandas, which only eat bamboo, have a highly specialized diet. Many endangered species are threatened because they live or forage in particular habitats that have been lost or converted to other uses. One well-known case, the northern spotted owl lives in cavities of trees in old-growth forests (forests with trees that are more than 200 years old and have not been cut, pruned, or managed), but these forests have been heavily logged, reducing the owl's habitat.

In contrast, species with broad niches are generalists that can adapt to wider ranges of environmental conditions within their own lifetimes (i.e., not through evolution over generations, but rather through changes in their behavior or physiologic functioning) and survive on diverse types of prey. Coyotes once were found only on the Great Plains and in the western United States, but have spread through the eastern states in part because of their flexible lifestyle. They can kill and eat large, medium, or small prey, from deer to house cats, as well as other foods such as invertebrates and fruit, and can live in a range of habitats, from forests to open landscapes, farmland, and suburban neighborhoods [(footnote 7)](http://www.learner.org/courses/envsci/footnote/unit4.html).

Overlap between the niches of two species (more precisely, overlap between their resource use curves) causes the species to compete if resources are limited. One might expect to see species constantly dying off as a result, but in many cases competing species can coexist without either being eliminated. This happens through [niche partitioning](http://www.learner.org/courses/envsci/glossary/definition.php?invariant=niche_partitioning) (also referred to as resource partitioning), in which two species divide a limiting resource such as light, food supply, or habitat.